

Lattice IsoTruss Structures for Wind Turbine Towers

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Composites work well in wind turbine blades.

Could composites be used in other parts of wind infrastructure too?

Outline

- Problem
- Composites in Infrastructure
- IsoTruss® Technology
- Composite Wind Towers
- Conclusion

Wind Towers

- Large turbines have steel towers
- Challenges
 - Components are so large that **transportation** is difficult
 - **Installation** of large, heavy pieces is expensive
 - **Corrosion**, especially in off-shore locations, can be a problem

NREL 50MW Reference Turbine

- Turbine Class: I
- Turbulence Class: B
- Drive Train: Geared
- 3 Blades
- Hub Height: 90 m
- Rotor Diameter: 126 m
- Tower Height: 88m
- Tower Diameter: 6m at base, 4m at top
- Wall Thickness: 0.03m to 0.02m
- Mass: 256,000 kg

Composites in Infrastructure

(Joe Fox)

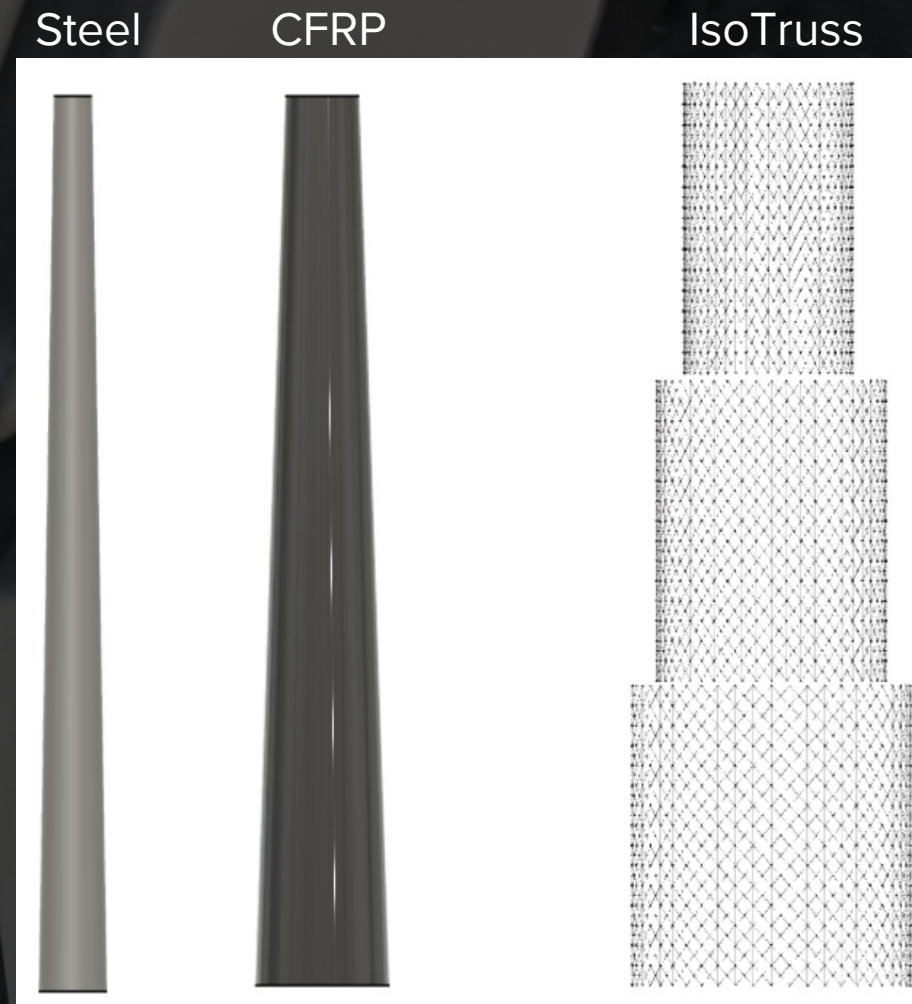
- **Lightweight**
- **Easy to install**
- Resilient
- **Corrosion resistant**
- Durable
- Transparent to RF
- Energy absorbing

IsoTruss® Technology



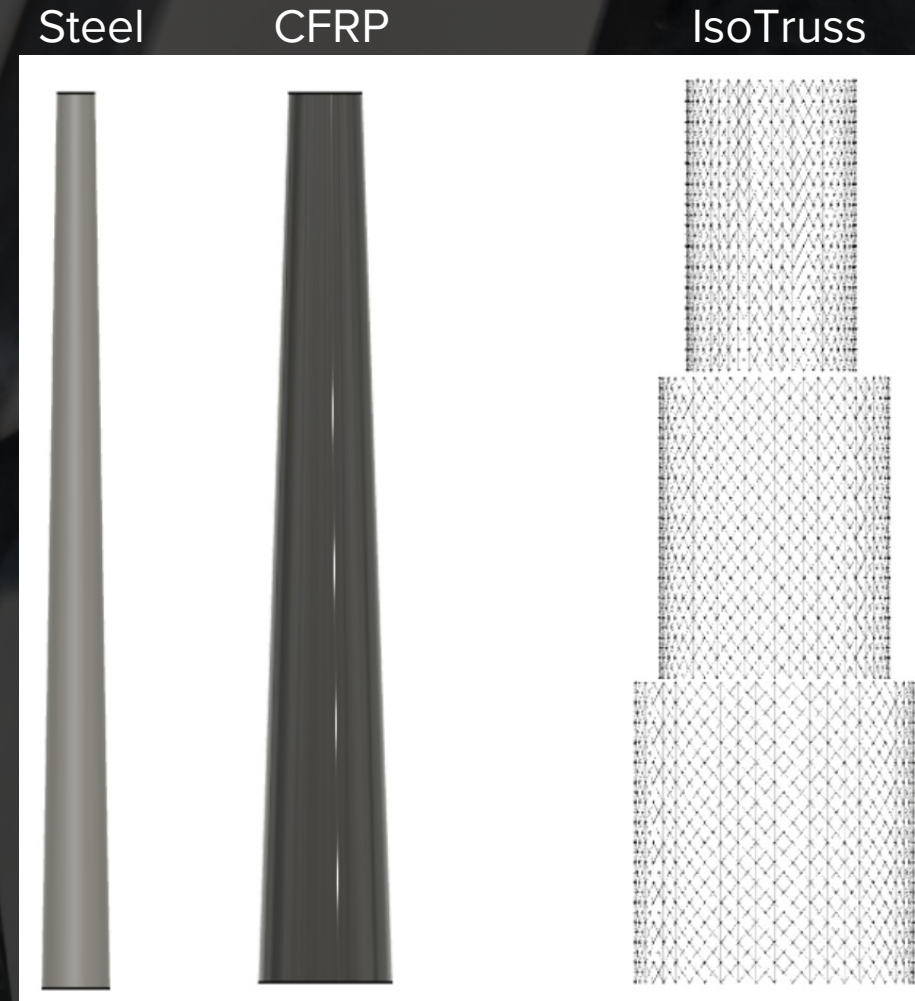
Composite Monopoles

	Steel	CFRP	IsoTruss
Base Diameter m [ft]	6 [20]	15 [50]	30 [100]
Top Diameter m [ft]	4 [13]	8 [26]	13 [42]
Wall Thickness cm [in]	2.5 [1]	2.5 [1]	2.5 [1]
Weight kg [lb]	2.6e5 [5.5e5]	1.2e5 [2.6e5]	1.1e4 [2.4e4]



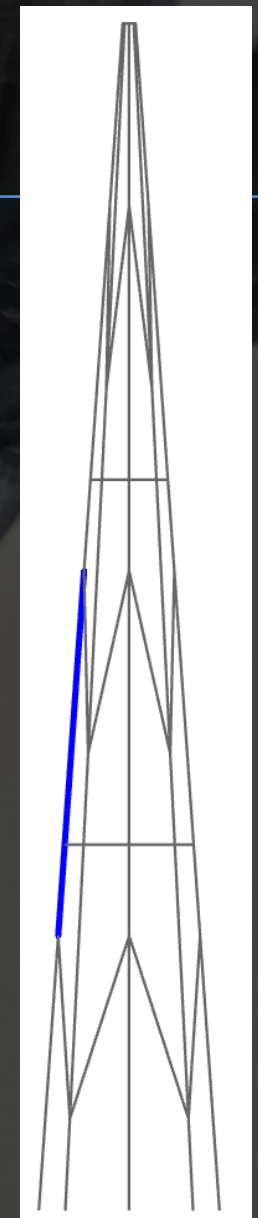
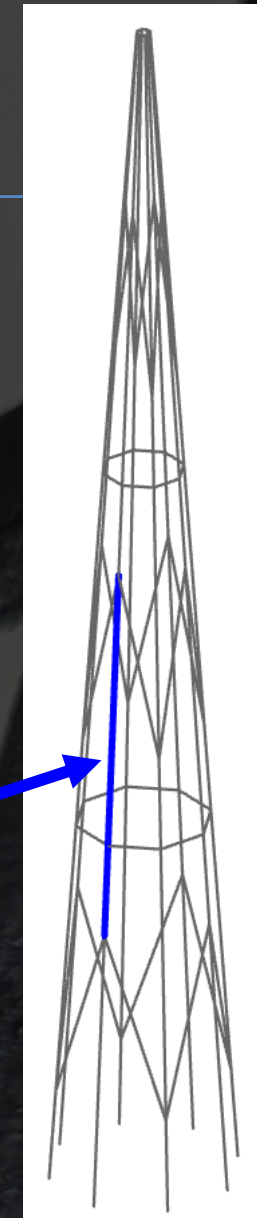
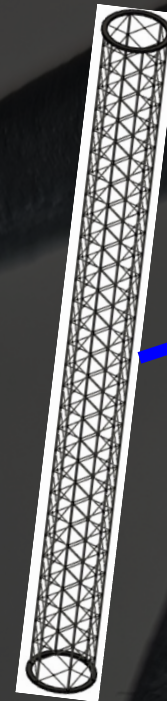
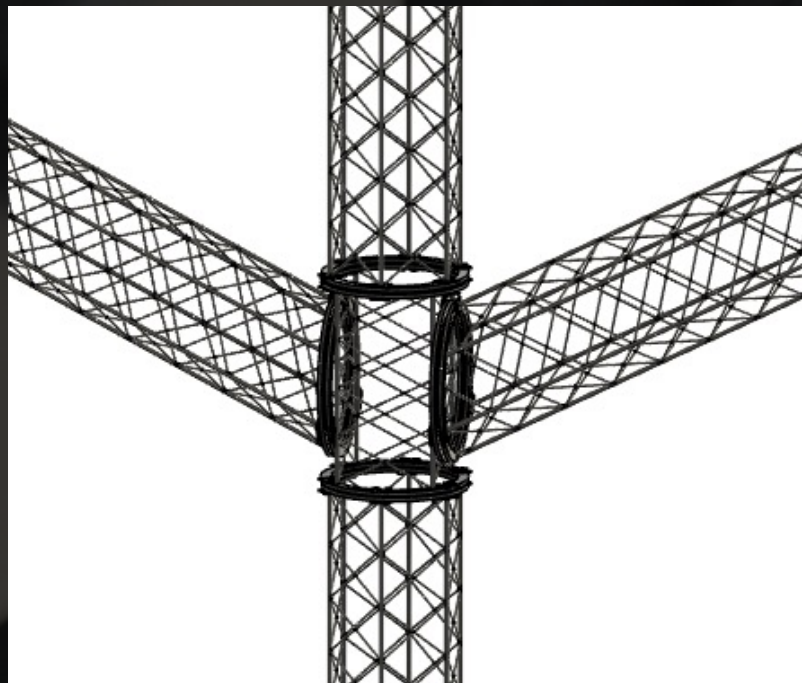
Composite Monopoles

- **Transportation**: more difficult than steel because diameter is larger
- **Installation**: lighter weight but larger – maybe about the same as steel?
- ✓ **Corrosion**: more resistant



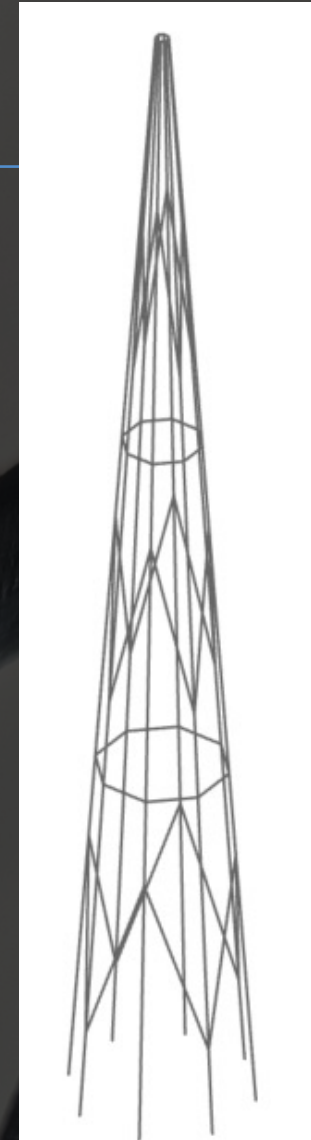
Modular IsoTruss Tower

- Each segment is a 40-inch IsoTruss
- Joints connect IsoTruss sections
- Shipped in pieces, assembled onsite



Modular IsoTruss Tower

	Steel	CFRP	IsoTruss	Modular IsoTruss
Base Diameter m [ft]	6 [20]	15 [50]	30 [100]	6 [20]
Top Diameter m [ft]	4 [13]	8 [26]	13 [42]	4 [13]
Wall Thickness cm [in]	2.5 [1]	2.5 [1]	2.5 [1]	2.5 [1]
Weight kg [lb]	2.6e5 [5.5e5]	1.2e5 [2.6e5]	1.1e4 [2.4e4]	1.5e5 [3.1e5]



Composite Towers

Factor Compared to Steel

	Steel	CFRP	IsoTruss	Modular IsoTruss
Base Diameter	6 m [20 ft]	2.5x	5x	1x
Top Diameter	4 m [13 ft]	2x	3x	1x
Wall Thickness	2.5 cm [1 in]	1x	1x	1x
Weight	2.6e5 kg [5.5e5 lb]	0.5x	0.04x	0.6x

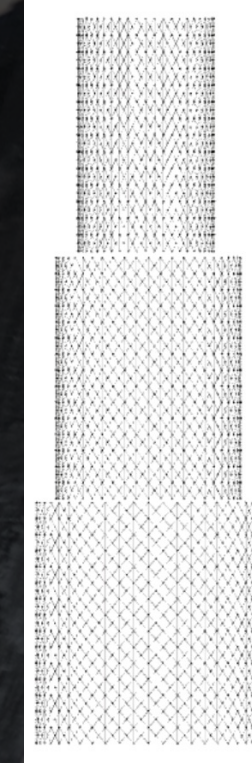
Steel



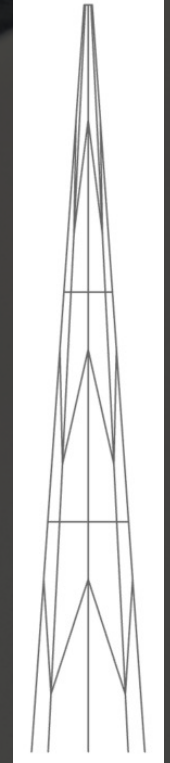
CFRP



IsoTruss

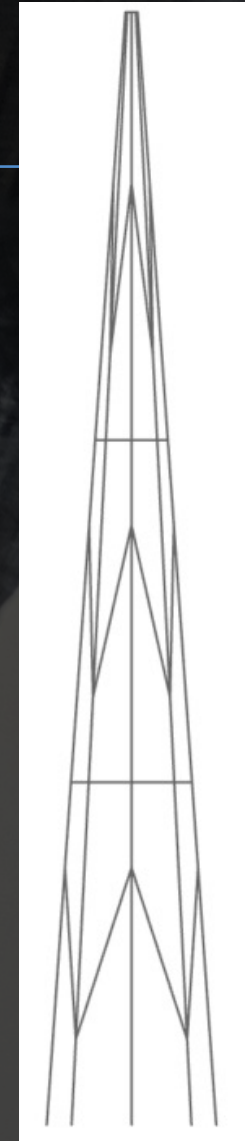
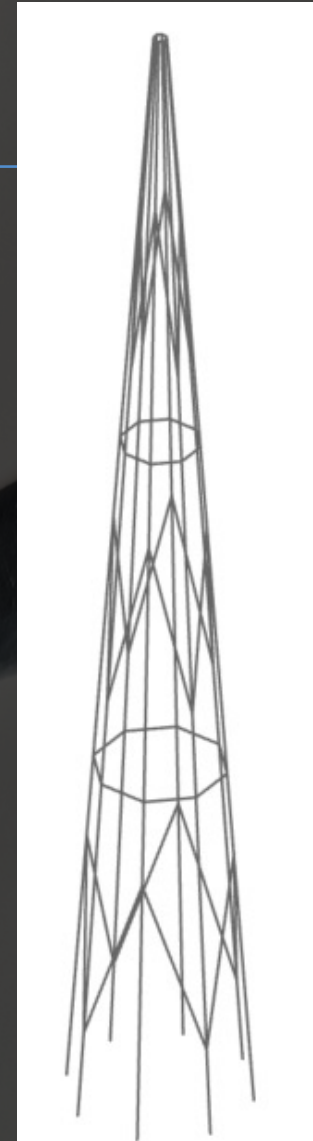


Modular IsoTruss



Modular IsoTruss Tower

- ✓ **Transportation**: small IsoTruss much easier to ship
- ✓ **Installation**: lighter weight and smaller pieces
- ✓ **Corrosion**: more resistant



Conclusion

- Takeaway: Lattice composite wind towers show considerable promise
- Upcoming in project
 - Cost analysis (steel vs IsoTruss) for lifetime costs
 - Demonstration piece

Acknowledgements

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